U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

4.5.1 CONTROL ROD DRIVE STRUCTURAL MATERIALS

REVIEW RESPONSIBILITIES

Primary - Materials and Chemical Engineering Branch (~~MTEB~~EMCB)[1]

Secondary - None

I. AREAS OF REVIEW

General Design Criterion 26 requires that one of the reactivity control systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that fuel design limits are not exceeded under conditions of normal operation, including anticipated operational occurrences. The areas listed below relating to materials considerations in the design of the control rod drive mechanism are reviewed. The review areas are similar to those given in Standard Review Plan Section 5.2.3, "Reactor Coolant Pressure Boundary Materials." For the purpose of this SRP section, the control rod system is comprised of the control rod drive mechanism (CRDM) and extends only to the coupling interface with the reactivity control (poison) elements in the reactor vessel; it does not include the electrical and hydraulic systems necessary for actuating the CRDMs.

1. Materials Specifications

The properties of the materials used in the control rod drive are reviewed from the standpoint of adequate performance throughout the design life of the plant (or component). Materials commonly used include austenitic stainless steels (which may be cold worked),[2] chromium-plated stainless steels, martensitic stainless steels, precipitation-hardening stainless steels such as 17-4 PH, and other special-purpose

materials such as cobalt-base alloys (Stellites), Inconel-750, Colmonoy-6, and Graphitar-14.

2. Austenitic[3] Stainless Steel Components

Areas of review for austenitic stainless steel components are similar to the applicable subsections of SRP Section 5.2.3 covering fabrication and processing of austenitic stainless steels.

The use of sensitized stainless steels should be controlled to prevent stress-corrosion cracking of the material during operation of the plant. Welding procedures should be controlled to reduce the probability of sensitization and microfissure formation. Cold-worked stainless steels should not have high yield stress, to reduce the probability of stress-corrosion cracking during operation of the plant.

3. Other Materials

Special requirements for ~~the other~~ materials other than austenitic stainless steels[4] include tempering and aging temperatures for martensitic and precipitation-hardening stainless steels to prevent their deterioration by stress corrosion during operation of the plant. The compatibility of these materials with the reactor coolant is reviewed to assure that they will continue to perform satisfactorily throughout the life of the component.

Metallic and non-metallic materials used in the control rod drive mechanism and not included in Appendix I to Section III, Division 1[5] of the ASME Boiler and Pressure Vessel (B&PV)[6] Code (Reference 9, hereinafter "the Code")[7] are identified.

4. Cleaning and Cleanliness Control

Proper care should be taken in handling the materials and parts of the control rod drive mechanism during fabrication, shipping, and onsite storage to assure that all cleaning solutions, processing compounds, degreasing agents, and other foreign materials are completely removed, and that all parts are dried and properly protected following any flushing treatment with water.

Review Interfaces[8]

EMCB also performs the following related reviews under the SRP Sections indicated:

1. Evaluates the adequacy of programs for assuring the integrity of bolting and threaded fasteners as part of its primary review responsibility for SRP Section 3.13 (proposed).[9]

2. Evaluates the portions of the control rod drive system that are part of the reactor coolant pressure boundary (RCPB) and verifies that the materials of construction and related fabrication controls satisfy the criteria applicable to RCPB materials, as part of its primary review responsibility for SRP Section 5.2.3.[10]

3. Evaluates portions of control rod drives that are reactor vessel attachments or appurtenances and verifies that the materials of construction and related fabrication controls satisfy the criteria applicable to reactor vessel materials, as part of its primary review responsibility for SRP Section 5.3.1.[11]

4. Determines the acceptability of the reactor coolant chemistry and associated chemistry controls (including additives such as inhibitors) as it relates to corrosion control and compatibility with control rod drive structural materials, as part of its primary review responsibility for SRP Sections 5.4.8 "Reactor Water Cleanup System (BWR)" and 9.3.4 "Chemical and Volume Control System (PWR)."[12]

In addition, ~~MTEB~~EMCB[13] will coordinate other branches' evaluations that interface with the overall review of the system as follows:

1. ~~the~~The Mechanical Engineering Branch (~~MEB~~EMEB[14]) reviews the mechanical aspects of the control rod drive[15] system other than the reactivity control elements as part of its primary responsibility for SRP Section 3.9.4.

2. The ~~Core Performance Branch (CPB)~~ Reactor Systems Branch (SRXB)[16] reviews the mechanical design, thermal performance, and chemical compatibility of the reactivity control elements as part of its primary responsibility for SRP Section 4.2.

3. The Emergency Preparedness and Radiation Protection Branch (PERB) evaluates the plant design, including the selection of materials to minimize activation products, to verify that occupational radiation exposures will be as low as is reasonably achievable (ALARA), as part of its primary review responsibility for SRP Section 12.1.[17]

For those areas of review identified above as ~~being reviewed as part of the primary review responsibility of other branches~~part of the review under other SRP sections, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP sections ~~of the corresponding primary branch~~.[18]

II. ACCEPTANCE CRITERIA

~~MTEB~~EMCB[19] acceptance criteria are based on meeting the relevant requirements of the following regulations:[20]

~~a~~A. General Design Criterion 1 as it relates to structures, systems, and components (SSC)[21] important to safety being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

~~b~~B. General Design Criterion 14 as it relates to the reactor coolant pressure boundary being designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

~~c~~C. General Design Criterion 26 as it relates to the control rods being capable of reliably controlling reactivity changes so that specified acceptable fuel design limits are not exceeded.

~~d~~D. Section 50.55a, of Title 10 of the Code of Federal Regulations, Part 50 as it relates to ~~structures, systems, and components~~ SSCs[22] ~~shall~~ being[23] designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed.

Specific acceptance criteria necessary to meet the relevant requirements of GDC 1, 14, and 26 and Section 50.55a of 10 CFR Part 50 are as follows:

1. Materials Specifications

The properties of the materials selected for the control rod drive mechanism must be equivalent to those given in Appendix I to Section III, Division 1 of the ~~ASME Boiler and Pressure Vessel~~ Code ~~(hereinafter "the Code")~~,[24] or in[25] Parts A, ~~and~~ B, and C[26] of Section II of the Code. ~~or are included in Regulatory Guide 1.85, "Code Case Acceptability ASME Section III Materials," except that c~~ Cold-worked[27] austenitic stainless steels shall have a 0.2% offset yield strength no greater than 620 MPa (90,000 psi)[28], to reduce the probability of stress corrosion cracking occurring in these systems. Regulatory Guide 1.85~~, "Code Case Acceptability ASME Section III Materials,"~~[29] describes the acceptable code cases that may be used in conjunction with the above specifications.

2. Austenitic[30] Stainless Steel Components

Acceptance criteria used ~~are similar to~~ include criteria described in SRP Section 5.2.3, subsections II.4.~~a, b, d,~~ and e and the criteria described below.[31]

Regulatory Guide 1.44~~, "Control of the Use of Sensitized Stainless Steel,"~~[32] describes acceptance methods for preventing intergranular corrosion of stainless steel components. Furnace-sensitized material should not be allowed, and methods described in this guide should be followed for cleaning and protecting austenitic stainless steels from contamination during handling, storage, testing, and fabrication, and for determining the degree of sensitization that occurs during welding. Regulatory Guide 1.31~~, "Control of Ferrite Content in Stainless Steel Weld Metal,"~~[33] describes acceptance criteria for assuring the integrity of welds in stainless steel components of these systems.

The controls for abrasive work on austenitic stainless steel surfaces should, as a minimum, be equivalent to the controls described in Regulatory Guide 1.37 position C.5 to prevent contamination which promotes stress corrosion cracking. Tools which contain materials that could contribute to stress-corrosion cracking or which, because of previous usage, may have become contaminated with such materials, should not be used on austenitic stainless steel surfaces.[34]

3. Other Materials

All materials for use in this system must be selected for their compatibility with the reactor coolant, as described in Articles NB-2160 and NB-3120 of the Code. The tempering temperature of martensitic stainless steels and the aging temperature of precipitation-hardening stainless steels should be specified to provide assurance that these materials will not deteriorate because of stress corrosion cracking in service. Acceptable heat treatment temperature include aging at 565° - 595°C (1050° - 1100°F)[35] for Type 17-4 PH and 565°C (1050°F)[36] for Type 410 stainless steel.[37]

4. Cleaning and Cleanliness Control

Onsite cleaning and cleanliness control should be in accordance with Regulatory Guide 1.37~~, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants,"~~[38] and ANSI N45.2.1-1973, "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants~~."~~(Reference 12).[39] The oxygen content of the water in vented tanks is not required to be controlled. Vented tanks with deionized or demineralized water are a normal source of water for final cleaning or flushing of finished surfaces. Halogenated hydrocarbon cleaning agents should not be used.

Technical Rationale[40]

The technical rationale for application of the above acceptance criteria to the control rod drive structural materials is discussed in the following paragraphs:

1. GDC 1 and 10 CFR 50.55a require that structures, systems, and components (SSCs) be designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed. 10 CFR 50.55a also incorporates by reference applicable editions and addenda of the ASME Boiler and Pressure Vessel Code. The control rod drive system provides a means for positioning control rods to effect reactivity control and comprises a part of the RCPB. Application of 10 CFR 50.55a and GDC 1 to the control rod drive structural materials provides assurance that established standard practices of proven or demonstrated effectiveness for selecting materials, fabrication, and testing/inspection of components are used to achieve a high likelihood that these safety functions will be performed.

2. GDC 14 requires that the RCPB be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. The RCPB provides a fission product barrier and a confined volume for the inventory of reactor coolant. The RCPB includes portions of the control rod drive system. Application of GDC 14 assures that control rod drive materials are selected, fabricated, installed, and tested to provide a low probability of significant degradation and in the extreme, gross failure of the RCPB that could cause substantial reduction in capability to contain reactor coolant inventory and/or reduction in capability to confine fission products.

3. GDC 26 establishes requirements regarding the reactivity control systems redundancy and capability. GDC 26 requires a control rod system, preferably including a positive means for inserting the rods, that is capable of reliably controlling reactivity changes to ensure that specified acceptable fuel design limits are not exceeded. The control rod drive system provides a means for rod positioning including insertion to effect reactivity control. Application of GDC 26 to the control rod drive system materials ensures material selection and fabrication supporting the capability for reliable rod movement to effect reactivity control, thereby preserving fuel and cladding integrity, the primary barriers to the release of fission products.

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case.

To ascertain that the acceptance criteria given in subsection II of this SRP section are met, the reviewer examines the review areas listed in subsection I of this SRP section for the required information, using the following procedures:

1. Material Specifications

The reviewer compares the properties of the material proposed for the control rod system with Appendix I to Section III, Division 1[41] of the Code, ~~and~~[42] Parts A, B, and C of Section II of the Code, and/or acceptable material code cases described in Regulatory Guide 1.85.[43] ~~He~~The reviewer[44] verifies that cold-worked austenitic stainless steels used in fabrication of the reactivity control mechanisms are in conformance with subsection II.1, above.

2. Austenitic Stainless Steel Components

Review procedures ~~are similar to~~include those described in SRP Section 5.2.3, subsections III.4.~~a, b, d,~~ and e.[45] The methods of controlling sensitized stainless steel are examined by the reviewer and compared with the positions given in Regulatory Guide 1.44, especially with respect to cleaning and protection from contamination during handling and storage, verification of non-sensitization of the material, and qualification of welding process employed in production using ASTM A-262 (Reference 10)[46]. If alternative methods of testing the qualification welds for degree of sensitization are proposed by the applicant, the reviewer determines if these are satisfactory, taking into account branch positions taken on previous applications and the degree of equivalence of the alternate methods. The reviewer may ask the applicant to justify the technical basis for any departures for the cited positions. Alternative tests that have been accepted by the branch include the use of ASTM A-708 (Reference 11)[47].

The methods of controlling and measuring the amount of delta ferrite in stainless steel weld deposits are examined by the reviewer and compared to the positions in Regulatory Guide 1.31, ~~"Control of Ferrite Content in Stainless Steel Weld Metal,"~~[48] especially with respect to the filler metal acceptance procedures for the determination of delta ferrite

content. If alternative positions are proposed by the applicant, the reviewer determines if these are satisfactory, taking into account branch positions taken on previous applications. The reviewer may ask the applicant to justify the technical basis for any departures from the acceptance criteria stated in subsection II.2 of this SRP section.

The applicant's description of abrasive work controls for austenitic stainless steel surfaces is reviewed and is verified as adequate to minimize the cold-working of surfaces and the introduction of contaminants that may promote stress corrosion cracking.[49]

3. Other Materials

The reviewer examines the information provided in the applicant's safety analysis report (SAR) on the compatibility of the materials (other than austenitic stainless steels) to be used in contact with the reactor coolant. ~~He~~The reviewer[50] determines that the materials are compatible with the service environment so that unacceptable degradation due to[51] corrosion or stress corrosion of the component will not occur during the lifetime of the component. Metallic and nonmetallic materials identified in subsection I.3 of this SRP section are reviewed to assure compatibility and that loss of integrity will not occur during the life of the component.

Operating experience has indicated that certain nickel-chromium-iron alloys (e.g. Inconel) are susceptible to cracking due to corrosion. Inconel 690 alloy has improved corrosion resistance in comparison to Inconel alloy 600 previously used in reactor applications. Where nickel-chromium-iron alloys are proposed for use, the reviewer verifies that an acceptable technical basis is either identified (based upon demonstrated satisfactory use in similar applications) or presented by the applicant to support use of the material. Particular review emphasis is placed upon the corrosion resistance and stress corrosion cracking resistance properties of the proposed nickel-chromium-iron alloy(s).[52]

The reviewer determines that the tempering temperatures of all martensitic stainless steels and the aging temperatures of precipitation-hardening stainless steels have been specified and are in accordance with the acceptance criteria in subsection II.3 of this SRP section.

4. Cleaning and Cleanliness Control

The reviewer verifies that onsite cleaning and cleanliness control procedures are satisfactory and in accordance with subsection II.4 of this SRP section.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[53]

IV. EVALUATION FINDINGS

When the reviewer has verified that sufficient and acceptable information has been provided in accordance with the requirements of this SRP section, conclusions of the following type are prepared, to be included in the staff's safety evaluation report:

> The staff concludes that the control rod drive mechanism structural materials are acceptable and meet the requirements of General Design Criteria 1, 14, and 26 as well as 10 CFR Part 50, Section 50.55a. This conclusion is based on the applicant having demonstrated that the properties of materials selected for the control rod drive mechanism components exposed to the reactor coolant satisfy Appendix I of Section III, Division 1[54] of the ASME Code, and Parts A, B, and C of Section II of the Code, and having conformed[55] with the staff position that the yield strength of cold-worked austenitic stainless steel should not exceed 620 MPa (90,000 psi)[56]. For materials not selected in accordance with ASME Code provisions, ~~T~~the applicant has ~~met the guidelines of Regulatory Guide 1.85 by using~~used materials of construction that are ~~approved for use to~~ in accordance with the acceptable ASME code cases described in Regulatory Guide 1.85 or that have otherwise been demonstrated acceptable for the application.[57]
>
> In addition, the controls imposed upon the austenitic stainless steel of the mechanisms conform to the recommendations of Regulatory Guide 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal," Regulatory Guide 1.37, regulatory position C.5,[58] ~~and~~ Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel~~:~~," and the related criteria described in SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials."[59] ~~All materials selected for application in the control rod drive mechanism component are or will be in conformance with the applicable code case listed in Regulatory Guide 1.85, "Code Case Applicability ASME Section III Materials."~~[60] Fabrication and heat treatment practices performed in accordance with these recommendations provide added assurance that stress corrosion cracking will not occur during the design life of the component. The compatibility of all materials used in the control rod system in contact with the reactor coolant satisfies the criteria of Articles NB-2160 and NB-3120 of Section III, Division 1[61] of the Code. Both martensitic and precipitation-hardening stainless steels have been given tempering or aging treatments in accordance with staff positions. Cleaning and cleanliness control are in accordance with ANSI Standard N 45.2.1-1973, ~~"Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants,"~~[62] and Regulatory Guide 1.37~~;~~ ~~"Quality Assurance Requirements for Cleaning Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants."~~[63]

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[64]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[65] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[66]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES[67]

~~4~~1. 10 CFR Part 50, Section 50.55a, "Codes and Standards."

~~1~~2. 10 CFR Part 50, Appendix A, General Design Criterion 1, "Quality Standards and Records."

~~2~~3. 10 CFR Part 50, Appendix A, General Design Criterion 14, "Reactor Coolant Pressure Boundary."

~~3~~4. 10 CFR Part 50, Appendix A, General Design Criterion 26, "Reactivity Control System Redundancy and Capability.

~~9~~5. Regulatory Guide 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal."

~~10~~6. Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants."

~~11~~7. Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel."

~~12~~8. Regulatory Guide 1.85, ~~"Code Case Acceptability ASME Section III Materials."~~"Materials Code Case Acceptability ASME Section III Division 1."[68]

~~5~~9. ASME Boiler and Pressure Vessel Code, Section II, "Materials," Parts A, B, and C; and Section III, "Rules for Construction of Nuclear Plant Components," Division 1, including Appendix I; American Society of Mechanical Engineers.[69]

~~6~~10. ASTM, A-262-1970[70], "Detecting Susceptibility to Intergranular Attack in Stainless Steels"; Practice A ~~and~~ "Oxalic Acid Etch Test for Classification of Etch Structures of Stainless Steels"; Practice E, "Copper-Copper Sulfate-Sulfuric Acid Test for Detecting

Susceptibility to Intergranular Attack in Stainless Steels"; Annual Book of ASTM Standards, American Society for Testing and Materials.[71]

~~7~~11. ASTM A-708-1974[72], "Detection of Susceptibility to Intergranular Corrosion in Severely Sensitized Austenitic Stainless Steel~~.~~," Annual Book of ASTM Standards, American Society for Testing and Materials.[73]

~~8~~12. ANSI N45.2.1-1973, "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants," American National Standards Institute.[74]

SRP Draft Section 4.5.1
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB names and abbreviations	Editorial change made to reflect current PRB name, abbreviation, and responsibility for SRP Section 4.5.1.
2.	Editorial	Corrected spelling of "austenitic" and added apparently missing punctuation.
3.	Editorial	Corrected spelling of "austenitic."
4.	Editorial	Added clarification that "other materials," as used in this SRP section, refers to materials other than austenitic stainless steels.
5.	Reference verification	Added reference to Division 1 to reflect that Appendix I is an appendix of Section III, Division 1 of the Code in the 1989 edition.
6.	Editorial, Reference verification	Spelled out the term abbreviated as B&PV.
7.	SRP-UDP format item-reformat reference citations, Editorial	Added identification by reference number for the first citation of the ASME Code. Also added clarification that all further references to "the Code" refer to the ASME B&PV Code.
8.	SRP-UDP format item, Reformat Areas of Review	Added Review Interface subsection of Areas of Review using numbered paragraphs to be consistent with SRP-UDP required format so that reviews performed in other SRP Sections which are relevant to the overall review of control rod drive structural materials are detailed in their own subsection. Also reformatted existing description of review interfaces in numbered format.
9.	SRP-UDP Integration of Bolting Issues, Potential Impact 11936	Added a review interface reflecting reviews of bolting and threaded fastener programs under new SRP Section 3.13.
10.	**Integrated Impacts 282, 303, and 331**; Potential Impacts 21391, 25342, and 25343	Added a Review Interface reflecting that portions of the control rod drive system which are part of the RCPB are reviewed against criteria for RCPB materials, including criteria for RCPB material specifications, compatibility with environmental conditions, fracture toughness and prevention, and fabrication and processing of RCPB ferritic and austenitic stainless steel materials. It should be noted that ROCs 799, 800, and 805 are similar to those referenced above and have been processed in the proposed draft revision of SRP Section 5.2.3. It should also be noted that reviews of austenitic stainless steels using criteria and procedures "similar" to those of SRP Section 5.2.3 are already included in SRP Section 4.5.1.

Item	Source	Description
11.	**Integrated Impacts 282, 303, and 331**; Potential Impacts 21391, 25342, and 25343	Added a Review Interface reflecting that portions of the control rod drive system which are attachments or appurtenances of the reactor vessel are reviewed against criteria for reactor vessel materials, including criteria for reactor vessel material specifications, compatibility with environmental conditions, fracture toughness and prevention, and fabrication and processing of reactor vessel ferritic and austenitic stainless steel materials. It should be noted that Generic Letter 88-01 applies to BWR "reactor vessel attachments and appurtenances." ROCs 812, 815, and 816 are similar to those referenced above and recommend addition of Generic Letter 88-01 and NUREG-0313, Revision 2 as criteria for review of BWR reactor vessel austenitic stainless steel materials in the draft revision of SRP Section 5.3.1.
12.	Potential Impacts 22224 and 25349, Editorial	Added Review Interfaces reflecting review of reactor coolant chemistry specifications and controls (separately for BWRs and PWRs) as they relate to determining compatibility with control rod drive structural materials to be exposed to reactor coolant (see specific acceptance criterion II.3).
13.	Current PRB names and abbreviations	Editorial change made to reflect current SRP Section 4.5.1 PRB abbreviation.
14.	Current PRB names and abbreviations	Editorial change made to reflect current SRP Section 3.9.4 PRB name and abbreviation.
15.	Editorial	Added the word "drive" to further clarify that it is the drive system (not the rod system) which is reviewed under SRP Section 3.9.4.
16.	Current PRB names and abbreviations	Editorial change made to reflect current SRP Section 4.2 PRB name and abbreviation.
17.	Potential Impact 22223	Added a Review Interface to reflect reviews of material selection as it relates to ALARA objectives.
18.	SRP-UDP format item, Editorial	Revised to reflect standard SRP-UDP discussion of the criteria and reviews detailed in other SRP Sections in Areas of Review, Review Interfaces to address reviews by EMCB, as well as other branches.
19.	Current PRB names and abbreviations	Editorial change made to reflect current SRP Section 4.5.1 PRB abbreviation.
20.	SRP-UDP format item, editorial	Renumbered/relettered to improve the outline scheme used in subsection II.
21.	Editorial	Added the acronym SSC for Structures Systems and Components.

Item	Source	Description
22.	Editorial	Substituted the acronym SSC for Structures Systems and Components as is consistent with the remainder of the section.
23.	Editorial	Revised to improve grammar.
24.	Editorial	Modified citation to refer to "the Code" since a previous citation indicated that references to "the Code" refer to the ASME B&PV Code. Also added "Division 1" to the citation based upon the organization of the Code where Appendix I is an appendix of Division 1.
25.	Editorial	Added preposition to improve grammar.
26.	Potential Impacts 25347 and 25349, Reference verification	Revised to clarify that material properties equivalent to those given in Part C of Section II of the Code are also acceptable. It should be noted that Part C is already cited in Review Procedures and Evaluation Findings for this SRP section.
27.	Editorial, Reference verification	Revised to improve grammar and clarity, noting that use of Regulatory Guide 1.85 Code cases is discussed later in the paragraph. Also, since it was not verified that current Code material specifications allow a 0.2% offset yield strength of greater than 90,000 psi for cold-worked austenitic stainless steels, wording reflecting this as an exception to the Code was deleted.
28.	NRC Metrication Policy implementation	Added the SI equivalent of 90,000 psi and reformatted in SI units consistent with NRC metrication policy. See attached Metrication Documentation.
29.	Reference verification, SRP-UDP format item	Deleted obsolete title for Regulatory Guide 1.85 since current titles ofRegulatory Guides are provided in subsection VI, References.
30.	Editorial	Corrected spelling of "austenitic."
31.	SRP-UDP Consistency item, Editorial	Revised to clarify the criteria applied for those austenitic stainless steel components which are not part of the RCPB or are not reactor vessel attachments/appurtenances. The statement "similar to SRP Section 5.2.3, subsections II.4.a, b, d, and e" was modified since 1) the statement of criteria in such a fashion is ambiguous, 2) the referenced SRP Section 5.2.3 subsections II.a and II.b provide criteria which explicitly addresses compliance with different regulations (e.g. GDC 4) than listed as acceptance criteria for SRP Section 4.5.1.
32.	Reference verification, SRP-UDP format item	Deleted title for Regulatory Guide 1.44 since titles of Regulatory Guides are provided in subsection VI, References.

Item	Source	Description
33.	Reference verification, SRP-UDP format item	Deleted title for Regulatory Guide 1.31 since titles of Regulatory Guides are provided in subsection VI, References.
34.	**Integrated Impact 332**	Added specific criteria for abrasive work on stainless steel surfaces based upon RG 1.37 position C.5 related to grinding, and staff review of the issue as described in the CE System 80+ FSER.
35.	NRC Metrication Policy implementation	Added the SI equivalent of 1050-1100 degrees F and reformatted in SI units consistent with NRC metrication policy. See attached Metrication Documentation.
36.	NRC Metrication Policy implementation	Added the SI equivalent of 1050 degrees F and reformatted in SI units consistent with NRC metrication policy. See attached Metrication Documentation.
37.	Editorial	Revised to improve grammar so that an adjective does not end the sentence.
38.	Reference verification, SRP-UDP format item	Deleted title for Regulatory Guide 1.37 since titles of Regulatory Guides are provided in subsection VI, References.
39.	SRP-UDP format item, **Integrated Impact 305** (no change)	Added identification by reference number for the first citation of this reference per SRP-UDP format. The provisions of ANSI N45.2.1 were subsequently incorporated in NQA-1 and NQA-2 and these standards have now been merged into the latest version of NQA-1. The staff has not yet formally endorsed the most recent versions of these standards via issuance of an approved Regulatory Guide. Based upon Inspection Program Branch comments, no change to update citations of ANSI N45.2.1 is appropriate at this time, pending formal staff endorsement of a replacement standard.
40.	SRP-UDP format item	Technical Rationale were developed and added for the following Acceptance Criteria: GDCs 1, 14, and 26; and 10 CFR 50.55a. The SRP-UDP program requires that Technical Rationale be developed for the Acceptance Criteria.
41.	Reference verification	Added reference to Division 1 to reflect that Appendix I is an appendix of Section III, Division 1 of the Code in the 1989 edition.
42.	Editorial	Deleted conjunction to accommodate addition of another item to the list of reviewer references for this procedure.

Item	Source	Description
43.	Editorial	The use of acceptable Code Cases is permitted in the Acceptance Criteria (in specific criterion II.1), thus, the Review Procedure is revised toreflect that materials conforming to Code Cases described in Regulatory Guide 1.85 are also acceptable.
44.	Editorial	Revised to eliminate use of a gender specific pronoun.
45.	SRP-UDP Consistency item, Editorial	Revised to clarify the review procedures for those austenitic stainless steel components which are not part of the RCPB or are not reactor vessel attachments/appurtenances. The statement "similar to SRP Section 5.2.3, subsection III.4.a, b, d, and e" was modified since 1) the statement of procedures in such a fashion is ambiguous, 2) the referenced SRP Section 5.2.3 subsections III.a and III.b relate to verification of compliance with different regulations (e.g. GDC 4) than listed as acceptance criteria for SRP Section 4.5.1.
46.	SRP-UDP format item	Added identification by reference number for the first citation of this reference per SRP-UDP format.
47.	SRP-UDP format item	Added identification by reference number for the first citation of this reference per SRP-UDP format.
48.	Reference verification, SRP-UDP format item	Deleted title for Regulatory Guide 1.31 since titles of Regulatory Guides are provided in subsection VI, References.
49.	**Integrated Impact 332**	Added Review Procedures for review of abrasive work controls for stainless steel surfaces.
50.	Editorial	Revised to eliminate use of a gender specific pronoun.
51.	Editorial	Revised the text so that the procedure verifies freedom from unacceptable degradaton over the life of components rather than freedom from corrosion.
52.	**Integrated Impact 304**	Added Review Procedures for review of nickel-chromium-iron alloys proposed as control rod drive materials.
53.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
54.	Reference verification	Added reference to Division 1 to reflect that Appendix I is an appendix of Section III, Division 1 of the Code in the 1989 edition.
55.	Editorial	Revised to improve grammar.
56.	NRC Metrication Policy implementation	Added the SI equivalent of 90,000 psi and reformatted in SI units consistent with NRC metrication policy. See attached Metrication Documentation.

Item	Source	Description
57.	Editorial	Revised to clarify that 1) certain typically used materials are not addressed by the ASME Code, 2) Regulatory Guide 1.85 identifies acceptable material selection alternatives to those of the ASME Code but does not constitute additional criteria which all materials must satisfy, and 3) acceptance may also be based upon demonstrated adequacy of the material.
58.	**Integrated Impact 332**	Added finding related to grinding controls for austenitic stainless steel surfaces.This change was revised during SRP section integration to incorporate PRB comments. Specifically, the title of Regulatory Guide 1.37 was deleted since it appears earlier in the text of the SRP..
59.	Editorial	Since subsections II and III refer to SRP Section 5.2.3 for criteria and procedures applicable to review of austenitic stainless steels, a finding was added related to SRP Section 5.2.3 applicable criteria.
60.	Editorial	Revised for consistency with acceptance criteria and review procedures for austenitic stainless steels which do not cite or relate directly to Regulatory Guide 1.85. It should also be noted that not all materialsmust comply with code cases identified in Regulatory Guide 1.85.
61.	Reference verification	Added reference to Division 1 to reflect that cited Articles are located in Section III, Division 1 of the Code in the 1989 edition.
62.	PRB Comment, Editorial	Deleted ANSI N45.2.1 title since the title is provided earlier in subsection IV.
63.	Editorial	Deleted RG 1.37 title since the title is provided earlier in subsection IV.
64.	SRP-UDP Format Item, implementation of 10 CFR 52	Provided standard change to Evaluation Findings to address design certification reviews.
65.	SRP-UDP Format Item.	Added boiler-plate change to the Implementation subsection to incorporate 10 CFR 52.
66.	SRP-UDP Format Item.	Added boiler-plate change to the Implementation subsection to address applicability of the SRP section to existing and future license applications.
67.	SRP-UDP format item, Editorial	Renumbered and reordered listing of references to place references in numerical order by regulation/document number and so that regulations and other NRC publications precede non-NRC publications.
68.	Reference Verification, Editorial	Updated to reflect current title of RG 1.85.

Item	Source	Description
69.	Reference verification, Editorial	Revised reference listing to reflect titles of major Code sections and organization of the 1989 edition.
70.	**Integrated Impact 1379**	Revised the non-date-specific reference to ASTM A262 to cite the version in effect when the SRP was published.
71.	Reference verification, **Integrated Impact 307** (no change)	Revised reference listing to identify titles for ASTM A-262 Practices A and E. Did not revise to specify the 1993 version pending NRC acceptance of the standard comparison supporting such a change.
72.	**Integrated Impact 1380**	Revised the non-date-specific reference to ASTM A708 to cite the version in effect when the SRP was published.
73.	Reference verification	Revised reference listing to identify the source book for this ASTM standard which is now discontinued.
74.	Reference verification, **Integrated Impact 305** (no change)	The provisions of ANSI N45.2.1 were subsequently incorporated in NQA-1 and NQA-2 and these standards have now been merged into the latest version of NQA-1. The staff has not yet formally endorsed the most recent versions of these standards via issuance of an approved Regulatory Guide. Based upon Inspection Program Branch comments, no change to update citations of ANSI N45.2.1 is appropriate at this time, pending formal staff endorsement of a replacement standard.

[This Page Intentionally Left Blank]

SRP Draft Section 4.5.1
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
282	Revise the SRP to address staff positions, based upon NUREG-0313, Rev. 2 and Generic Letter 88-01, which are more restrictive than RG 1.44.	Areas of Review, subsection I, Review Interfaces 1 and 2 with other EMCB sections.
303	Revise the SRP to address staff positions for stainless steel weld metal which are more restrictive than RG 1.31.	Areas of Review, subsection I, Review Interfaces 1 and 2 with other EMCB sections.
304	Add Review Procedures for review of the acceptability of nickel-chromium-iron alloys as control rod drive materials.	Review Procedures subsection III.3.
305	Revise the SRP to cite ANSI/ASME NQA-2 in addition to Regulatory Guide 1.37 for cleanliness controls. Also consider revising Regulatory Guide 1.37 to cite ANSI/ASME NQA-2.	No changes in this proposed draft revision.
306	Revise the SRP to address staff positions supplementing EPRI Evolutionary Plant Utilities Requirements Document (URD) requirements for control of impurities/contaminants to which NSSS materials could be exposed.	No changes in this proposed draft revision.
307	Revise the SRP to cite the latest version of ASTM A-262. Also evaluate the latest version of ASTM A-262 for regulatory endorsement (in Regulatory Guides 1.37 and 1.44).	No changes in this proposed draft revision.
308	Remove all citations of ASTM A-708.	No changes in this proposed draft revision.
309	Evaluate the latest versions of AWS A4.2 and AWS A5.4 for regulatory endorsement (in Regulatory Guide 1.31).	No changes in this proposed draft revision.
331	Revise the SRP to address staff positions related to avoiding IGSCC in BWR austenitic stainless steel materials, based upon NUREG-0313, Rev. 2 and Generic Letter 88-01.	Areas of Review, subsection I, Review Interfaces 1 and 2 with other EMCB sections.
332	Revise the SRP to address staff positions related to abrasive work (e.g. grinding) on austenitic stainless steel which are more restrictive than RG 1.37.	Acceptance Criteria (specific criteria) subsection II.2; Review Procedures subsection III.2, Evaluation Findings subsection IV.
720	Perform standard comparison for ANSI N45.2.1 and consider citing the current version in RG 1.70.	No changes in this proposed draft revision.
1379	Update the non-date-specific citation of ASTM A262 to cite the 1970 version.	References, subsection VI, Reference 10.
1380	Update the non-date-specific citation of ASTM A708 to cite the 1974 version.	References, subsection VI, Reference 11.